SUPPLEMENTARY INFORMATION

Biosourced graphitic nanoparticles loaded hyperbranched polyurethane composites – Application as multifunctional high-performance coatings

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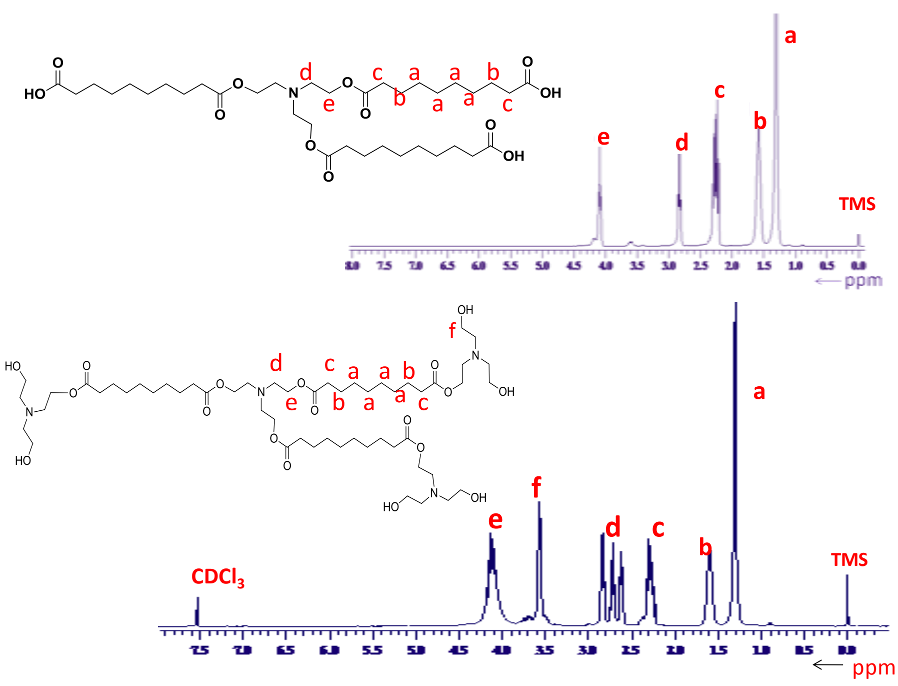


Fig. S1 ^{1}H NMR of SA-COOH and SA-OH

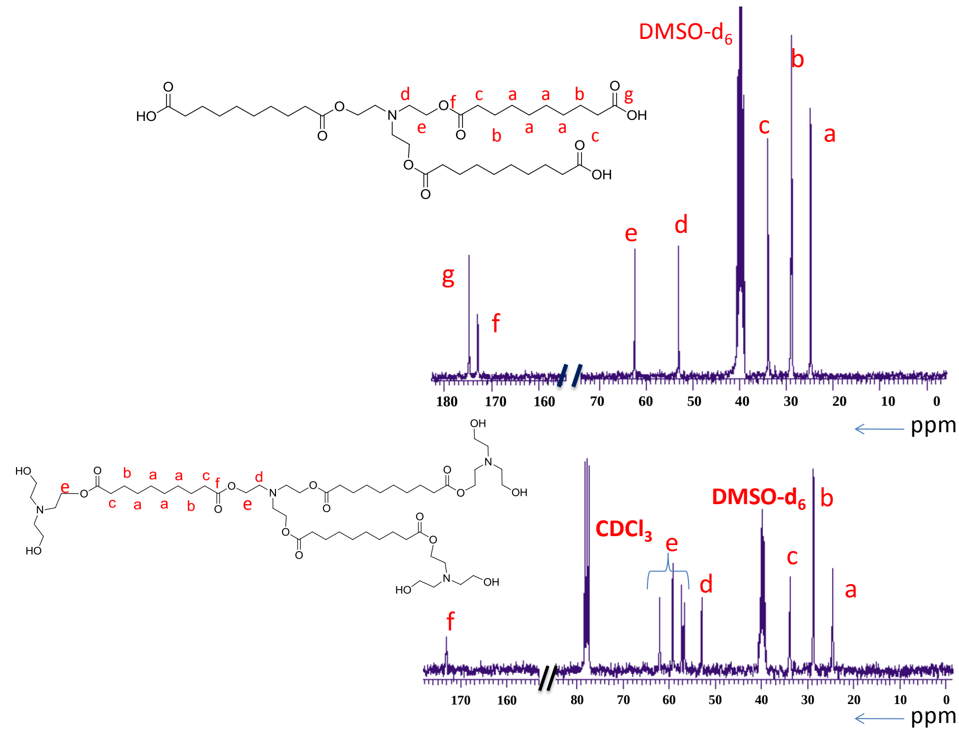


Fig.S2 ^{13}C NMR spectrum of SA-COOH and SA-OH

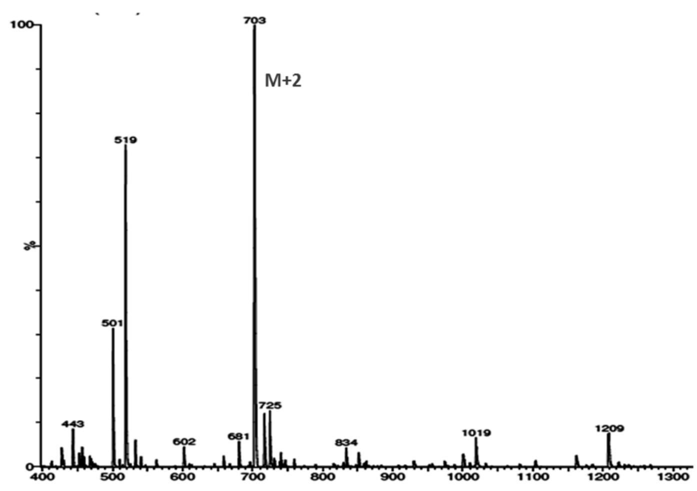


Fig. S3 ESI-MASS of SA-COOH

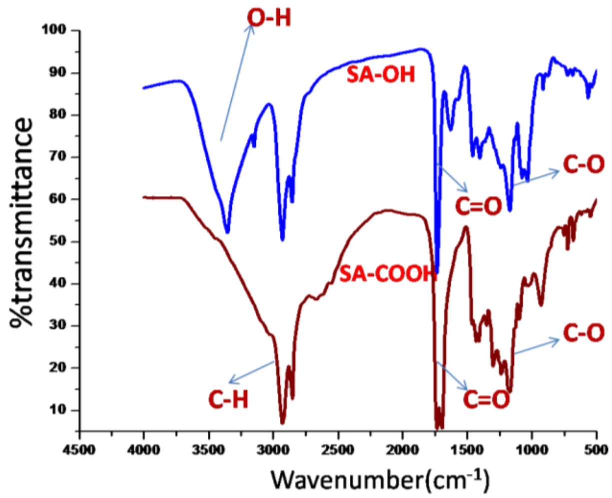


Fig. S4 FTIR overlay of SA-COOH and SA-OH

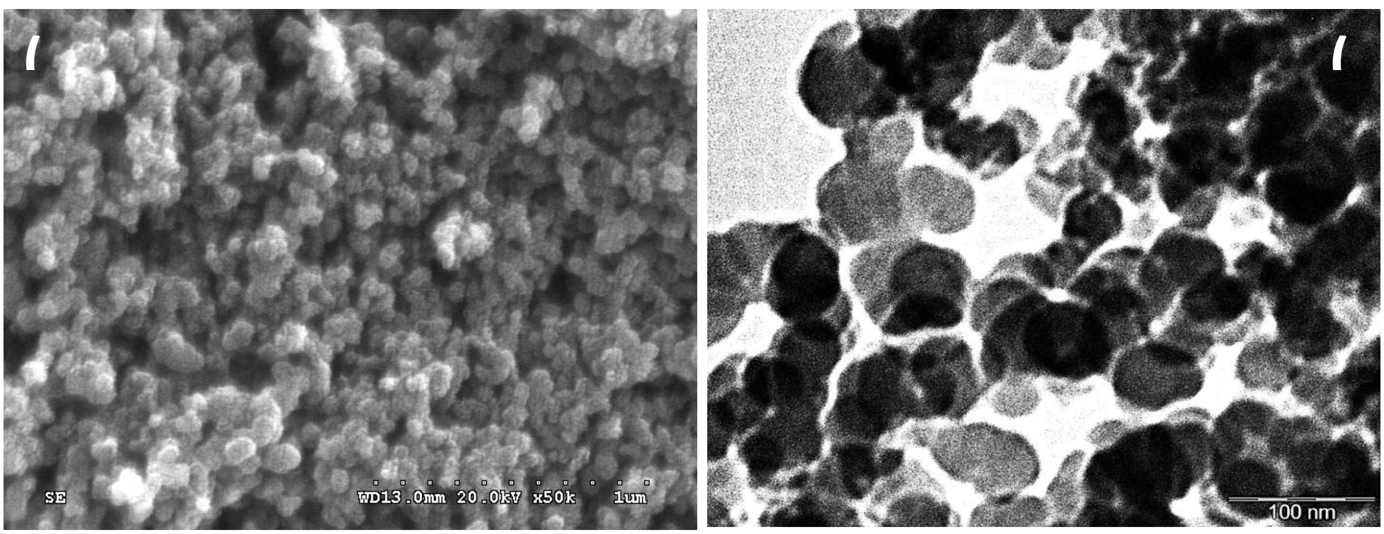


Fig. S5 (a) FESEM and (b) TEM images of GP-COOH

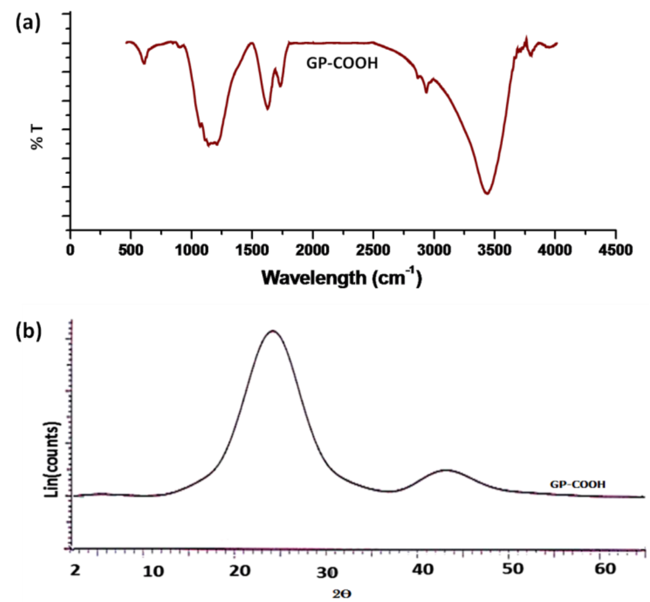


Fig. S6 (a) FTIR and (b) XRD profile of GP-COOH

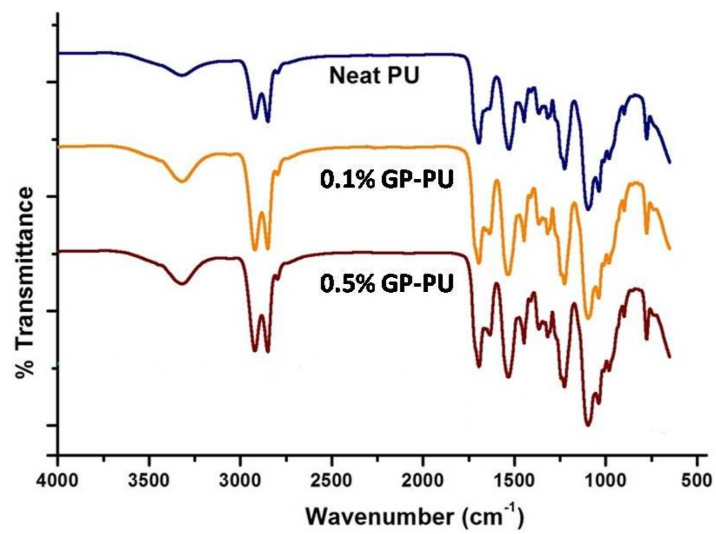


Fig. S7 FTIR overlay of different GP-PU hybrid composite films

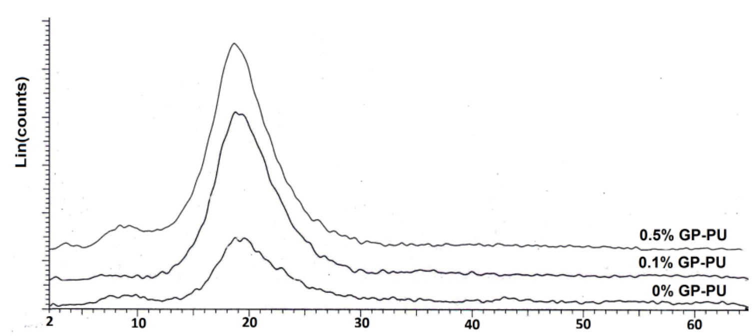
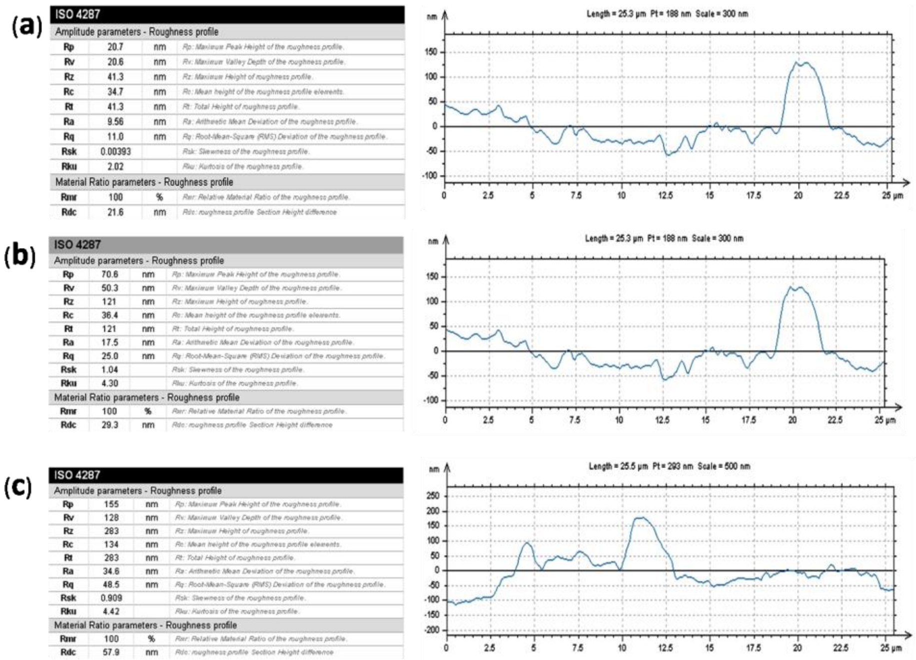


Fig. S8 XRD overlay of GP-PU hybrid films



(a)

ISO 4287			
Amplitude parameters - Roughness profile			
Rp	20.7	nm	Rp: Maximum Peak Height of the roughness profile.
Rv	20.6	nm	Rv: Maximum Valley Depth of the roughness profile.
Rz	41.3	nm	Rz: Maximum Height of roughness profile.
Rc	34.7	nm	Rc: Mean height of the roughness profile elements.
Rt	41.3	nm	Rt: Total Height of roughness profile.
Ra	9.56	nm	Ra: Arithmetic Mean Deviation of the roughness profile.
Rq	11.0	nm	Rq: Root-Mean-Square (RMS) Deviation of the roughness profile.
Rsk	0.00393		Rsk: Skewness of the roughness profile.
Rku	2.02		Rku: Kurtosis of the roughness profile.
Material Ratio parameters - Roughness profile			
Rmr	100	%	Rmr: Relative Material Ratio of the roughness profile.
Rdc	21.6	nm	Rdc: roughness profile Section Height difference

(b)

ISO 4287			
Amplitude parameters - Roughness profile			
Rp	70.6	nm	Rp: Maximum Peak Height of the roughness profile.
Rv	50.3	nm	Rv: Maximum Valley Depth of the roughness profile.
Rz	121	nm	Rz: Maximum Height of roughness profile.
Rc	36.4	nm	Rc: Mean height of the roughness profile elements.
Rt	121	nm	Rt: Total Height of roughness profile.
Ra	17.5	nm	Ra: Arithmetic Mean Deviation of the roughness profile.
Rq	25.0	nm	Rq: Root-Mean-Square (RMS) Deviation of the roughness profile.
Rsk	1.04		Rsk: Skewness of the roughness profile.
Rku	4.30		Rku: Kurtosis of the roughness profile.
Material Ratio parameters - Roughness profile			
Rmr	100	%	Rmr: Relative Material Ratio of the roughness profile.
Rdc	29.3	nm	Rdc: roughness profile Section Height difference

(c)

ISO 4287			
Amplitude parameters - Roughness profile			
Rp	155	nm	Rp: Maximum Peak Height of the roughness profile.
Rv	128	nm	Rv: Maximum Valley Depth of the roughness profile.
Rz	283	nm	Rz: Maximum Height of roughness profile.
Rc	134	nm	Rc: Mean height of the roughness profile elements.
Rt	283	nm	Rt: Total Height of roughness profile.
Ra	34.6	nm	Ra: Arithmetic Mean Deviation of the roughness profile.
Rq	48.5	nm	Rq: Root-Mean-Square (RMS) Deviation of the roughness profile.
Rsk	0.909		Rsk: Skewness of the roughness profile.
Rku	4.42		Rku: Kurtosis of the roughness profile.
Material Ratio parameters - Roughness profile			
Rmr	100	%	Rmr: Relative Material Ratio of the roughness profile.
Rdc	57.9	nm	Rdc: roughness profile Section Height difference

Fig. S9 Roughness profile of (a) 0% GP-PU, (b) 0.1% GP-PU and (c) 0.5% GP-PU

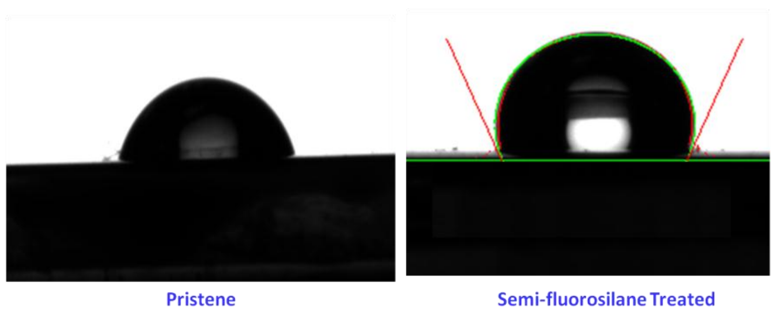


Fig. S10 Contact angle image of 0.5% GP-PU hybrid film

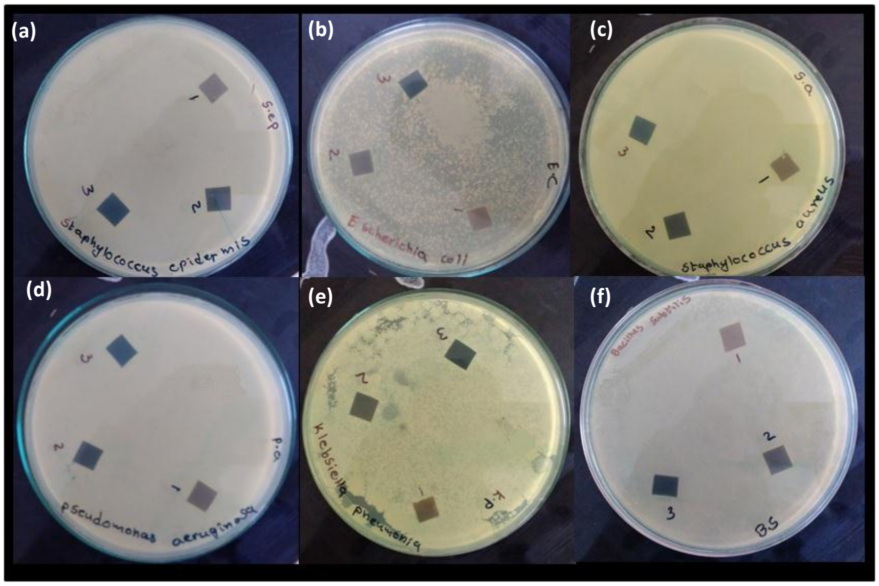


Fig. S11 Antibacterial activity of various GP-PUs tested with the following bacterial strains; (a)*Staphylococcus epidermis*, (b)*Escherichia Coli*, (c)*Staphylococcus aureus*, (d)*Pseudomonas Aeruginosa*, (e)*Klebsiella Pneumonia* and (f)*Bacillus subtilis*. (Within the figure 1, 2 and 3 represent 0%, 0.1% and 0.5% GP-PU respectively)

Calculation of the degree of branching:

The degree of branching is calculated by using the equation below

$$DB_{Frechet} = \frac{D + T}{D + L + T}$$

$$DB_{Frey} = \frac{2D}{2D + L}$$

Reference

A. R. Fornof, T. E. Glass and T. E. Long, *Macromolecular Chemistry and Physics.*, 2006, ***207***, 1197-1206.

Calculation of the corrosion rate:

The experimental setup consisted of a conventional three-electrode cell containing the working electrode, a saturated calomel electrode (SCE) and a counter electrode. Using the potentiostat of an electro-chemical workstation, the tests were performed by monitoring the current density as a function of the free open-circuit potential. After a stabilizing the solution for few minutes at room temperature, the potentio-dynamic polarization was carried out at a scan rate of 2 mV/s.

The corrosion current (i_{corr}) was estimated by linear fit and Tafel extrapolation to the cathodic and anodic part of the polarization curves. The corrosion rate depends on the kinetics of both anodic (oxidation) and cathodic (reduction) reactions. According to Faraday's law, there is a linear relationship between the metal dissolution rate or corrosion rate, R_c, and the corrosion current i_{corr}

$$Rc = \frac{tM}{nF\rho}\, i_{\mathrm{corr}}$$

where t is the exposure time, M is the atomic weight of the metal, ρ is the density, n is the charge number which indicates the number of electrons exchanged in the dissolution reaction and F is the Faraday constant, (96.485 C/mol). The ratio M/n is also sometime referred to as equivalent weight.

In the present case we have used galvanised steel panels coated with GP-PU.

Reference

Witte, F., Fischer, J., Nellesen, J., Crostack, H. A., Kaese, V., Pisch, A., and Windhagen, H. (2006). In vitro and in vivo corrosion measurements of magnesium alloys. *Biomaterials*, *27*(7), 1013-1018.